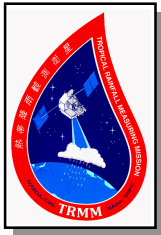


TRMM Monthly Status Briefing

January 12, 2000



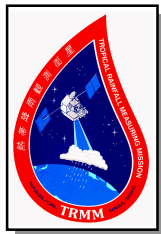
FOT Overview

- Operations Status - Engineering Staff
 - Flight Ops Summary - Lou Kurzmilller
 - Training & Certification Status - Lou Kurzmilller
 - Thermal, Electrical, & RCS - Andy Calloway
 - Deployables - Joe Kowalski
 - ACS, C&DH, & RF - Edwin Weidner
 - Power - Candace Shoemaker
 - CERES, LIS, & VIRS - Candace Shoemaker
 - TMI & PR - Joe Kowalski
 - Ground System - Edwin Weidner
 - Upcoming Activities - Andy Calloway



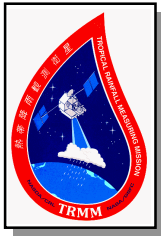
Flight Operations Summary

- Supported 544 SN events in December
 - 2 Yaw Maneuvers & 9 Delta-V Maneuvers
- 3 Event Rpts, 1 Generic Late Acq & no Anomaly Rpts generated
 - ER #144, #145, and #146
 - Rescheduled events for STS/Hubble and Terra
 - Base-wide power outage(PEPCO); No data loss from either
 - PTP failure; science data loss
- Significant Milestones
 - Commanded VIRS Blackbody temps
 - Delta-V of 29th Dec boosted TRMM higher than usual
 - Y2K operational scenario carried out; No mishaps



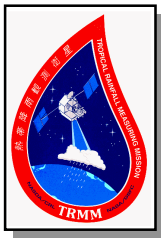
Flight Operations Summary

- Staffing
 - Personnel matters remain stable
 - Attempting to acquire one additional console analyst
 - Mgr's office to be relocated due to renovation



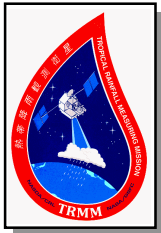
Training

- New hires working towards certification
 - All four are expected to complete Console Certification requirements in the next three weeks
 - All four have taken the on-line tests for Console Certification
 - Skills Catalog sign-offs in progress



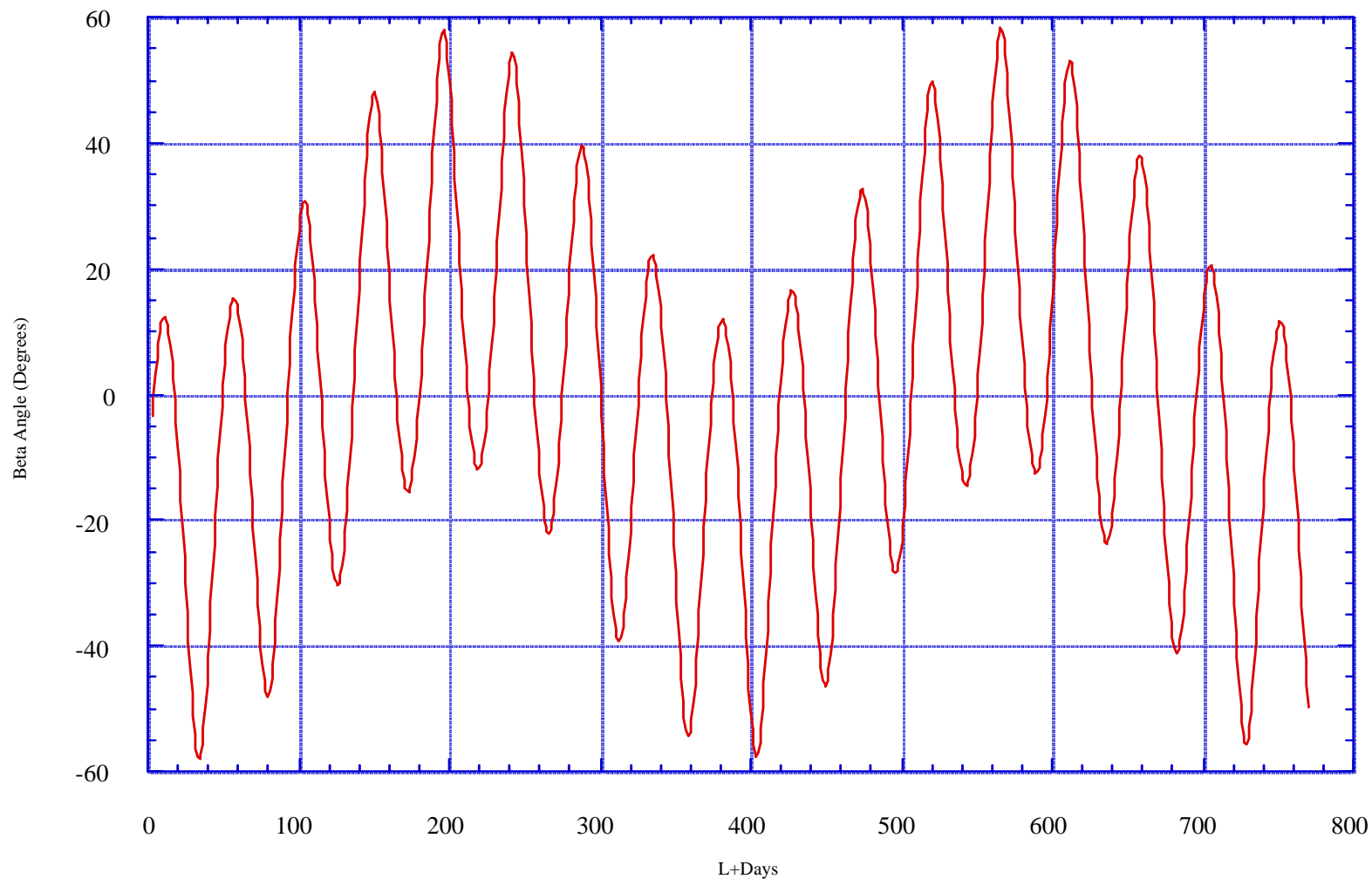
Thermal Subsystem

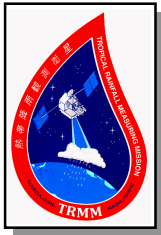
- Solar Beta angle cycle
 - Biggest influence on thermal behaviors
 - Two peaks per year at $+58^\circ$ and -58°
- High thermal conditions experienced on solar array drive remains a serious concern
- Thermal data being provided on monthly basis to Code 540 for analysis
 - Started in October 1999



Thermal Subsystem

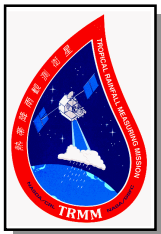
TRMM Solar Beta Angle Since Launch





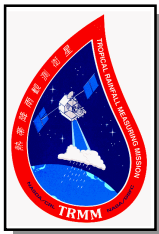
Electrical Subsystem

- Electrical subsystem is nominal



RCS Subsystem

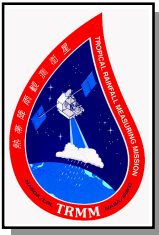
- Delta-V Maneuvers
 - 152 Maneuvers performed since launch, including the descent burns
 - Only two since launch not completed, due to constraints set too tight
 - Nine maneuvers in December: #143-151
 - Y2K Delta-V nominal with durations of 69.750 and 58.750 seconds
- Delta-V Operations
 - Three Delta-V operational changes introduced since launch
 - » Maneuver scheduling changed to every 4th day (#74 - #87)
 - » Burns no longer limited to integer seconds (starting with #82)
 - » Catbed heater on-time from 91 to 45 min (starting with #99)



RCS Subsystem

- Fuel Budget Analysis

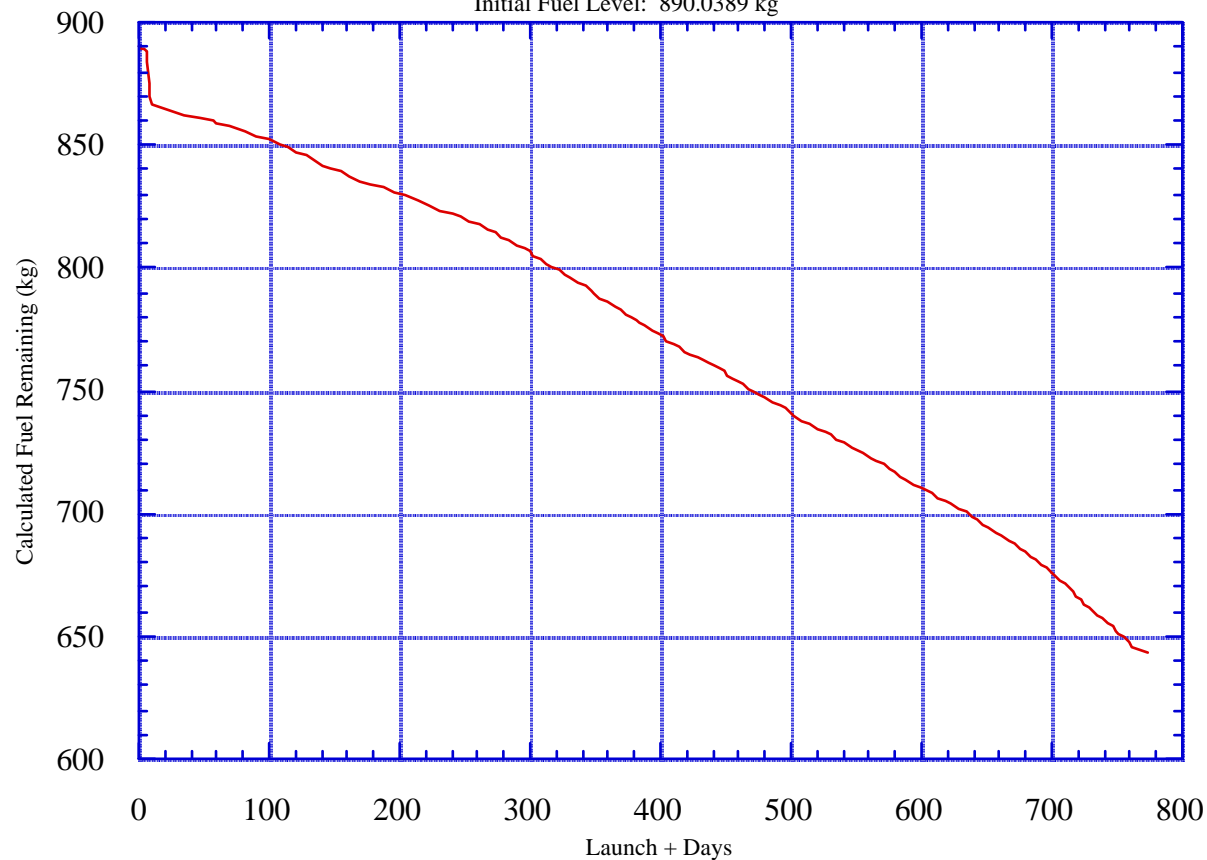
- Current mission life estimate is 6.4 years from launch if predicted solar flux levels continue (primary mission: 3 years)
- Reasons
 - » Predicted nominal pressure: 170 psia; Observed: 167.7 psia
 - » Thruster performance 5% better than pre-launch estimates
 - » Solar Flux levels in 98 and 99 lower than predicted
- Spreadsheet developed by FOT with RCS Code 713 engineers
 - » Outputs expected life by relating average daily fuel consumption with predicted solar flux levels
 - » Updated monthly

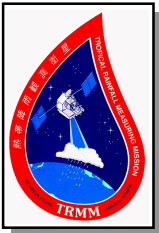


RCS Subsystem

TRMM Hydrazine Fuel Usage Summary

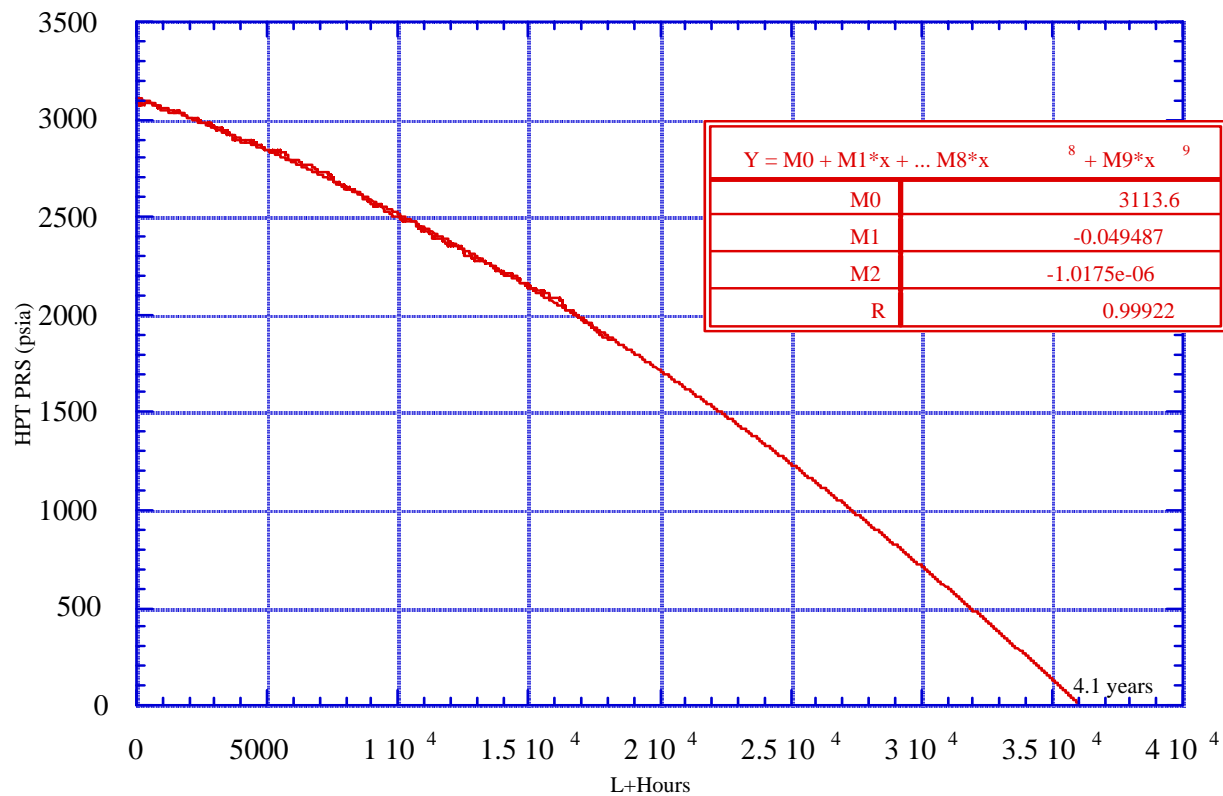
Initial Fuel Level: 890.0389 kg

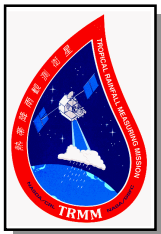




RCS Subsystem

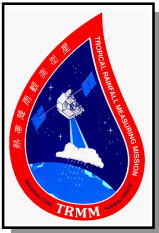
HPT Hourly Mean - No Descent



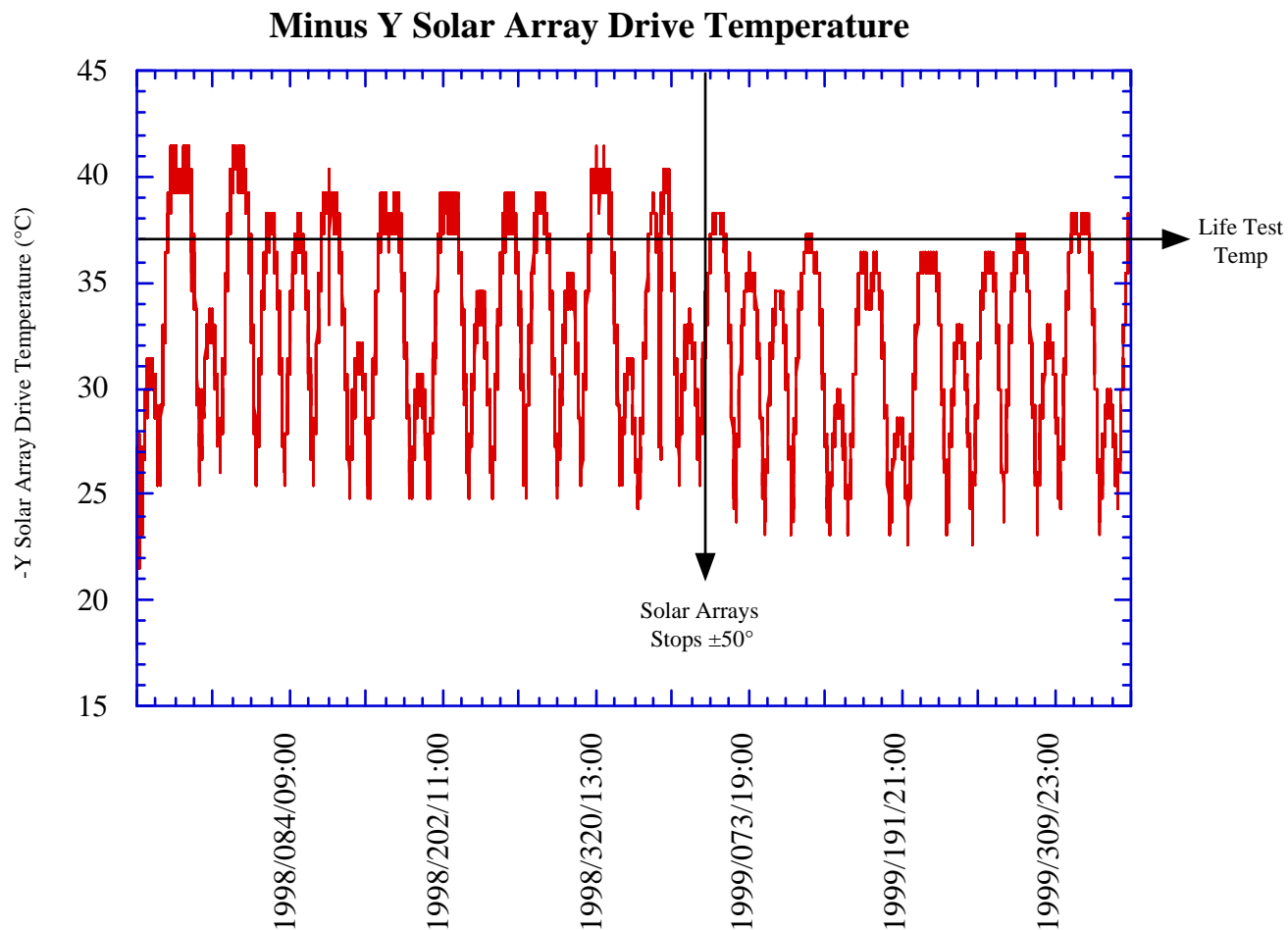


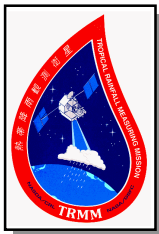
Deployables Subsystem

- -Y solar array drive temperature
 - A 10° C increase in temperature is 100 times more likely to evaporate the lubricant and may potentially cause undetected levels of metal particles
 - » Bearing temperature cannot be measured directly
 - Reaches maximum temperature at approximately beta angle 48° C
 - Has exceeded life test temperature of 37° C numerous times
 - » After solar array software stops were limited permanently to $\pm 50^\circ$ (originally $\pm 130^\circ$); drive temperature has been a few degrees cooler (see plot on next slide)
 - Currently solar array drive continues to operate with no signs of slippage



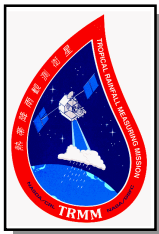
Deployables Subsystem





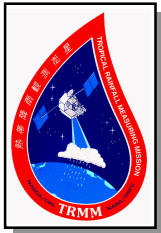
Deployables Subsystem

- -Y Solar Array Readiness Review held in June 99
 - Will not park -Y solar array at 30°; will remain with the status quo
 - FOT now focuses on detection of failed array
 - » Checklist
 - » TSMs for sensed vs commanded position
 - » On-console training includes solar array failure identification and early contingency steps
- Open Issues
 - Deployables AETD looking into the possibility of loading solar array stops to track past 90° to check the glitch buffer
 - » Risk Analysis to be conducted first

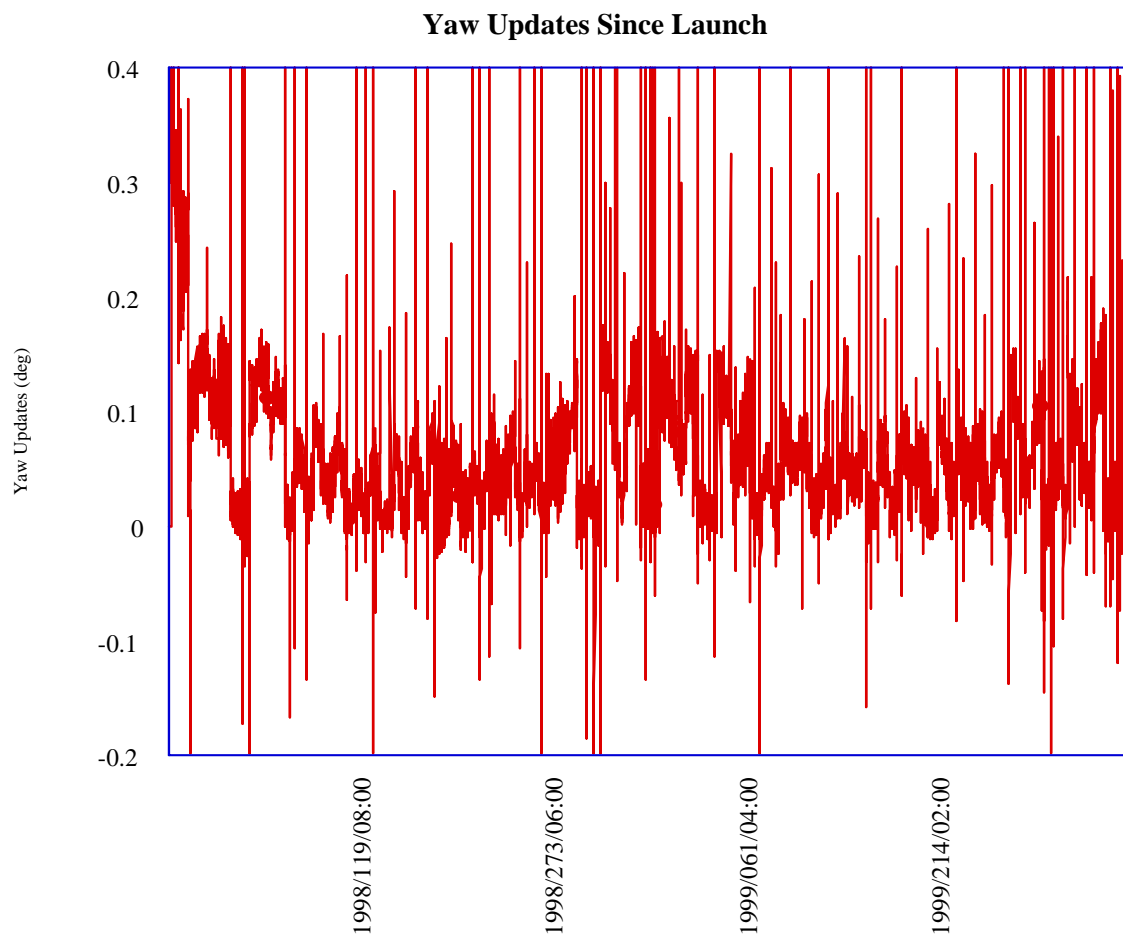


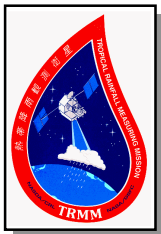
ACS Subsystem

- 2 Sun Acq occurrences since launch - limits set too tight; no actual problems with spacecraft
- Solar Array jitter (AR #74)
 - Experienced when Beta angle is above $\pm 54^\circ$
 - ACS software patch (CCR #052) used to reduce affect
 - » Change Solar Array Sun tracking code
 - Now uses Sun position based on the nominal attitude, instead of unfiltered gyro data
 - No problems experienced at last 2 Beta angle peaks: 99-328 (-55°) and 00-009 (-57°)
- Yaw updates show seasonal changes
 - Worst case still exceeds 1σ specifications
 - Believed to be due to ESA behavior



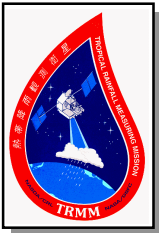
ACS Subsystem





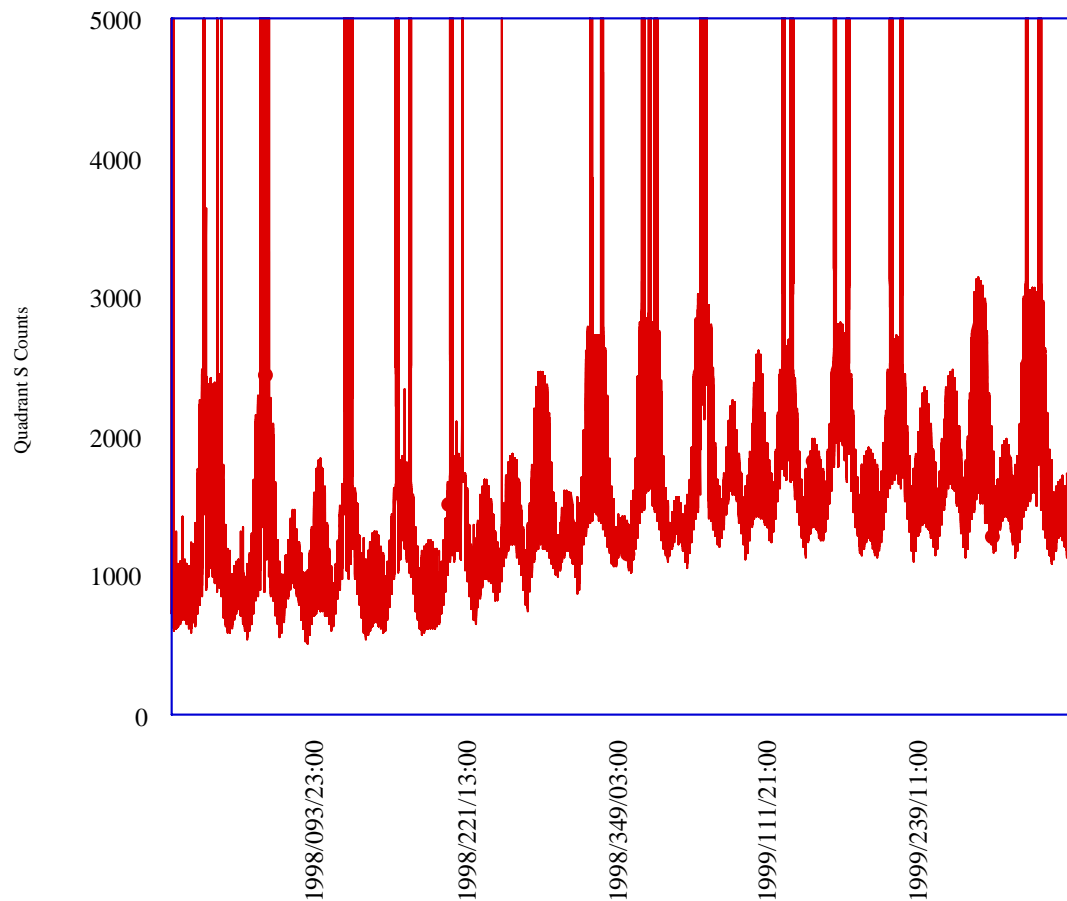
ACS Subsystem

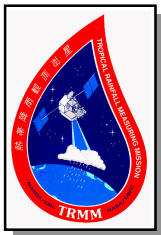
- TDRS EPVs still sometimes fail in position and velocity following TDRS maneuvers (AR #60 - CCR #035)
 - New table 85 with updated position & velocity limits uplinked
 - » Position Limit increased from 400 to 850 km
 - » Velocity Limit increased from 0.3 to 0.62 km/s
- ESA fogging
 - Focused in Quadrant 1
 - Action threshold is ~2500 counts
 - » Look into table bias changes
 - Manufacturer (Barnes) is not concerned with current performance



ACS Subsystem

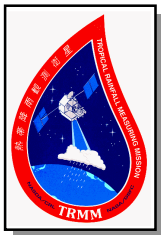
ESA S Counts for Quadrant 1





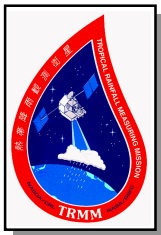
ACS Subsystem

- Potential Failure of -Y solar array
 - Contingency plan to fire one-shot thruster pulses to unload momentum if necessary
- Possibility of pitching S/C to warm PR in Safehold or Sun Acq
- Correction for Magnetic Field Epoch (CCR #005)
 - Awaiting ACS (Code 571&572) verification to update EEPROM
- Software bug found in ACS Flight Software (CCR #053)
 - Incorrectly defined algorithm array
 - Will not affect attitude so is not high priority
- Successfully performed Delta-V over 60 seconds for Y2K (required modifications to System tables #73 and #85)
- Correction of RTS #2



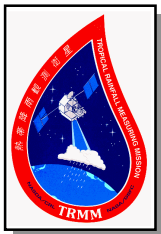
ACS Subsystem

- Open Issues
 - Commits to EEPROM
 - » Magfield Epoch and Solar Array Patches
 - » TDRS EPV Limits



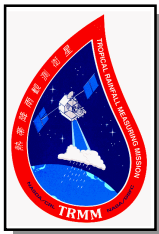
C&DH Subsystem

- Frequency Standard (FS) exhibits strong negative drift
 - Loses $\sim 0.1 \mu\text{s/hr/day}$
 - Adjusted approximately every 2 months
- 1773 Bus behaves as expected in atmospheric conditions
 - Retries: S/C= 1.0/d, ACS= 0.25/d, Inst= 1.5/d
 - Bit errors: Single= 55/d, Multi= 1 every 3 days
- PR retry error on 99-343
- Invalid Stream Identifications from VIRS/TMI
 - VIRS: 99-345, 357, and 361



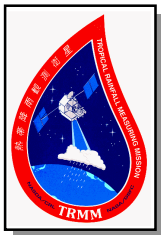
C&DH Subsystem

- UTCF allowed to drift full range of requirement ($\sim 900 \mu\text{s}$)
 - Adjusted on 99-355 and 00-006
 - Current UTCF value is 31535996.852754 sec
- Caveats of the system
 - Q-channel Restarts: can't handle odd frame
 - Flywheel (AR #51) on 99-341: lower half of orbit
 - No Memory Scrub task (MS) Not Present events: occur during release of large datasets



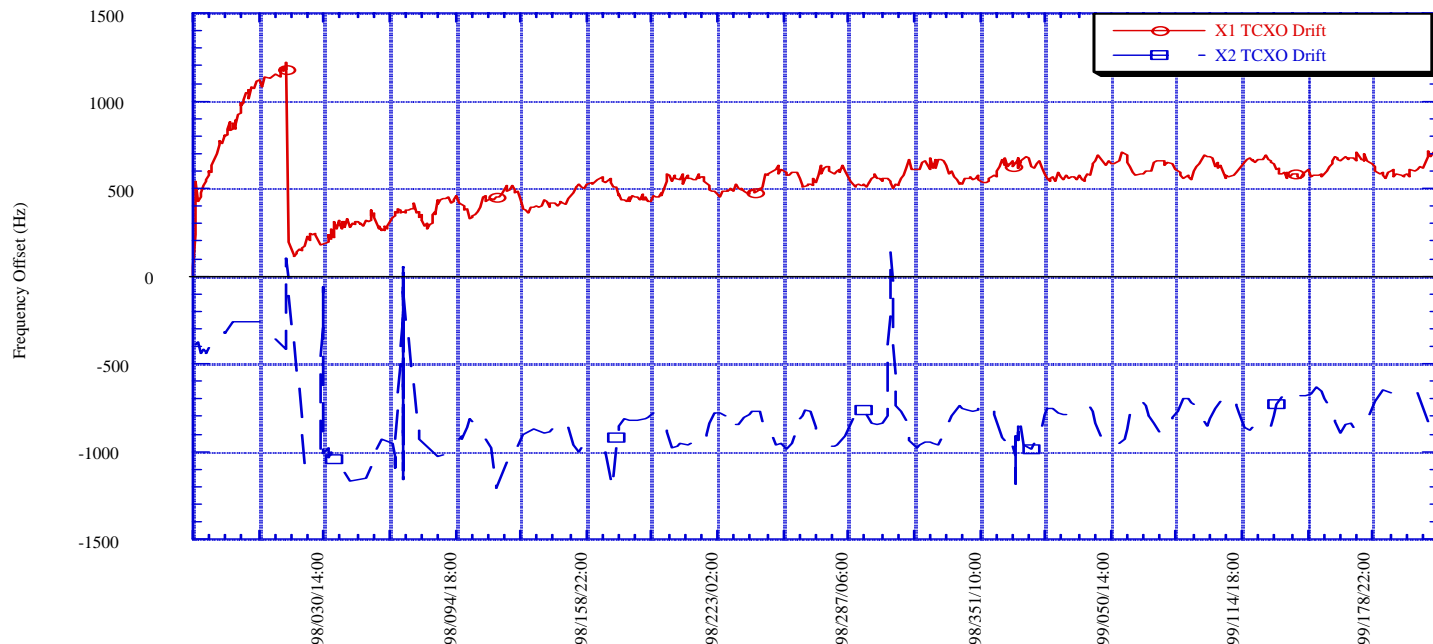
C&DH Subsystem

- Open Issues
 - Writing from RAM to EEPROM (CCR #034)
 - » Data Storage (DS) tables done
 - » Awaiting CERES modifications to contingency RTSs (CCR #045)
 - Eliminate all Launch monitors and RTSs (CCR #039)
 - Add TSM to monitor CERES current (CCR #057)
 - DS filter table change to record more ACE data (CCR #048)
 - No-clock software patch developed, although no indication of anomaly on FS B (CCR #047)
 - » Simulator being upgraded with ACS components to improve testing

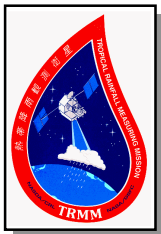


RF Subsystem

- Frequencies settled at approximately ± 700 Hz and drifting slightly
 - XP1 offset trended once a day, XP2 three times a week

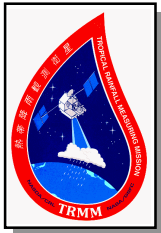


- Frequency Offset is ‘forgotten’ upon deacquisition
- Generic Late Acquisitions (99-365)
 - No indication of subsystem problem
 - Mostly seen on TDRS West



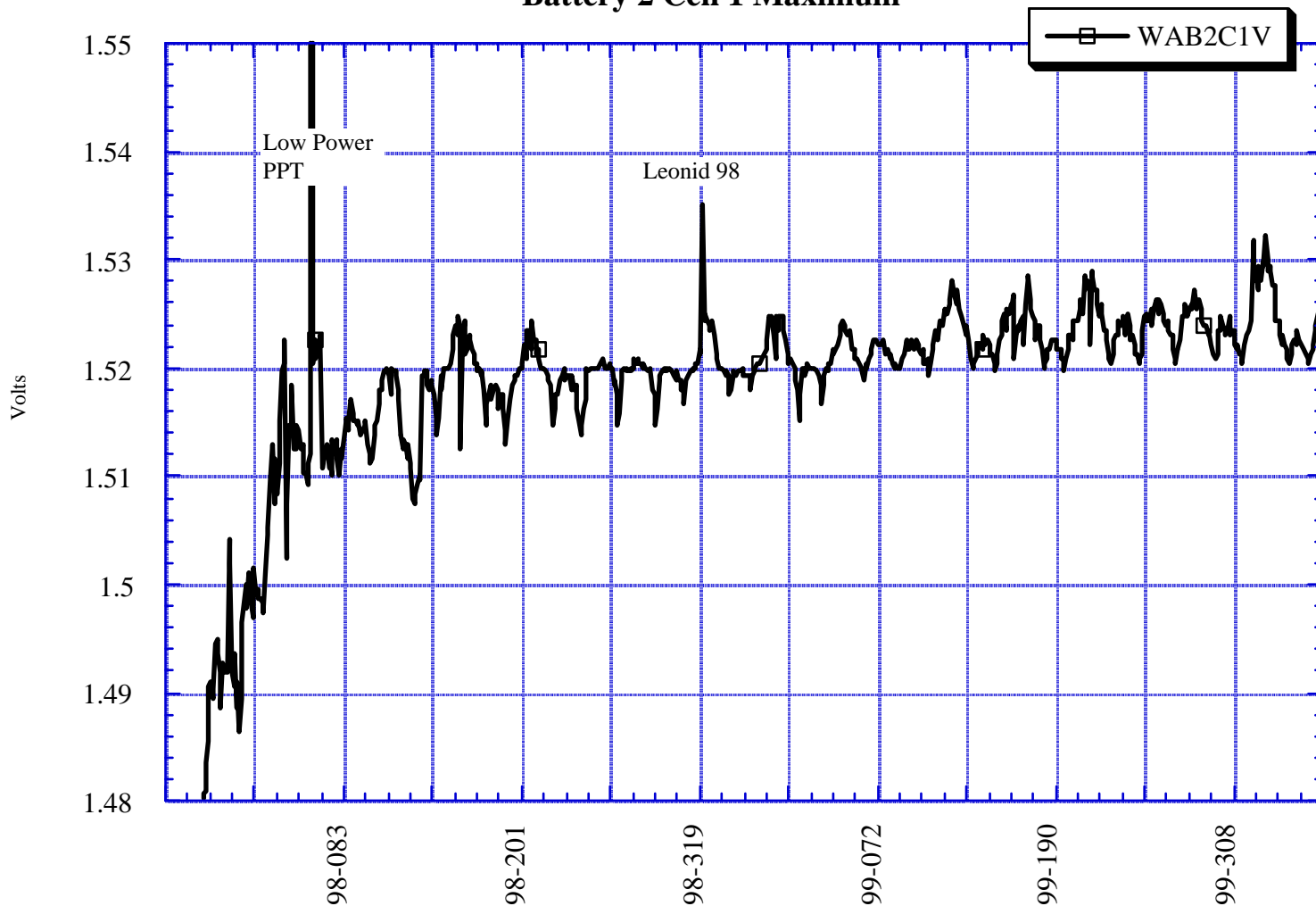
Power Subsystem

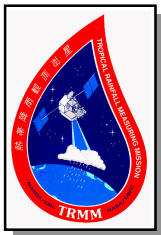
- Power analysis reports and trending provided to Code 563
- State of Charge counters not reaching 100% for all orbits at low Beta angles
 - C/D changed to 1.02 on 99-138 after TSMs # 31 and 32 limits reached (currently at 1.025)
- Battery 2 Cell 1 high cell voltage Anomaly #55 (on 98-028)
 - On 98-062, PSIB B turned on to rule out telemetry problem
 - TSMs #31 - 34 and RTS #13 added to prevent PSIB misconfiguration (EOD SOC drops below 95%)
 - Several charge setting changes to reduce peak - no effect
 - Report made “Inactive”
 - » Manufacturer has not given satisfactory explanation to close report



Power Subsystem

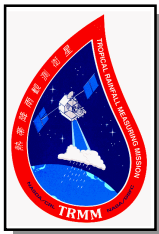
Battery 2 Cell 1 Maximum





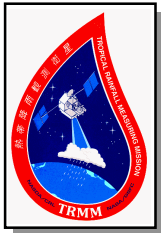
Power Subsystem

- Open Anomalies
 - #73 PSIB tick counter stopped incrementing on 99-138
 - » Currently have procedure to command PSIB memory to restart timers
 - » Flight Software working on a PSIB code patch to correct several routines found to have faulty logic (CCR #49 and 50)
 - Test Results Review to be held in January
 - Uplink planned for January

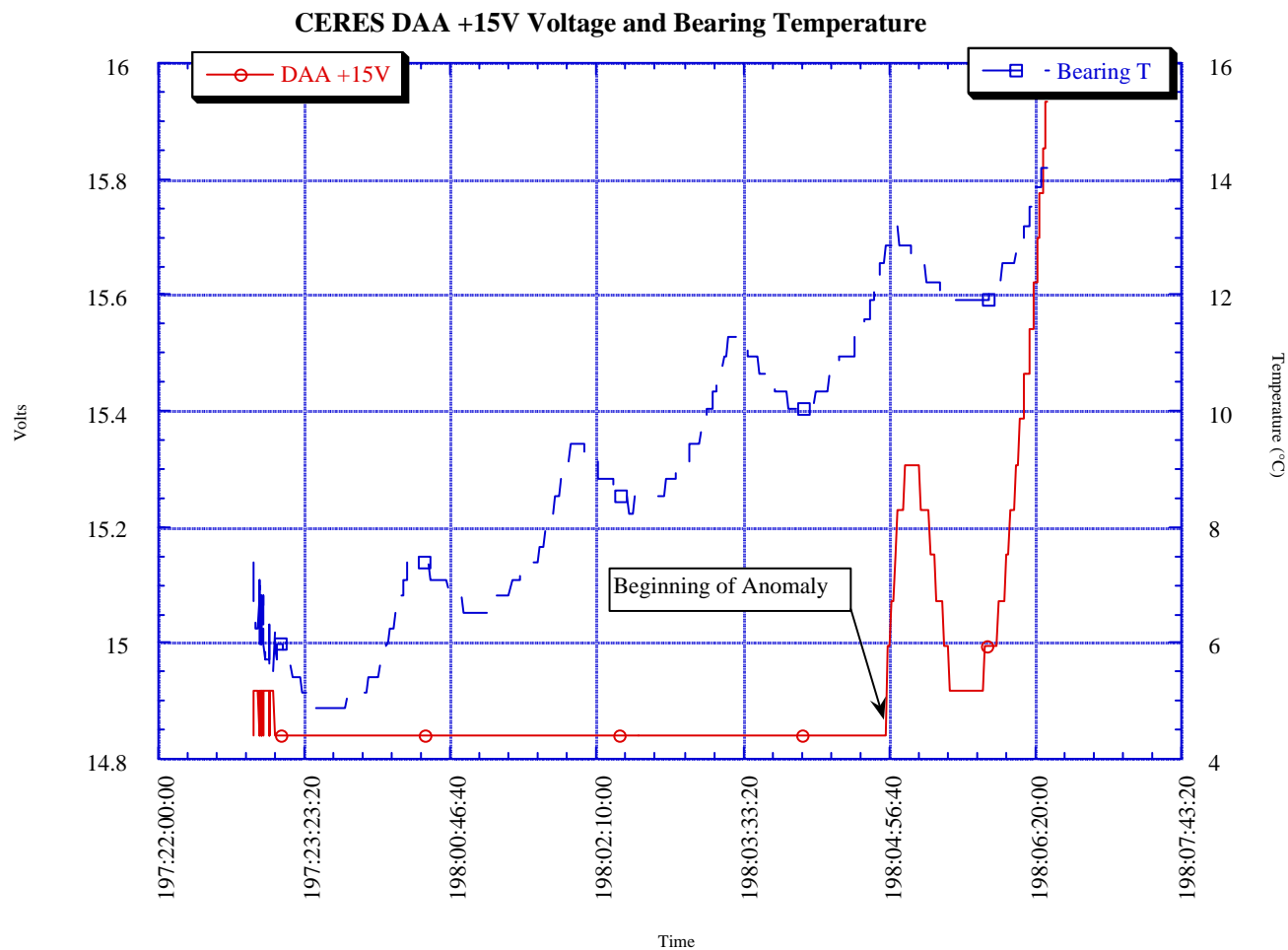


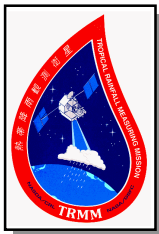
CERES Instrument

- AR #69: +15 V Data Acquisition Assembly (DAA) converter voltage hit high limits on 98-230
 - Powered OFF 98-244
 - Powered ON for short periods to coordinate science testing with other instruments and ground sites: ScaRaB instrument, INDOEX, Hawaii, and Australia
 - The LaRC *CERES +15V Anomaly Report* details the cause of the converter failure



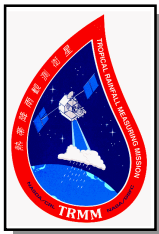
CERES Instrument





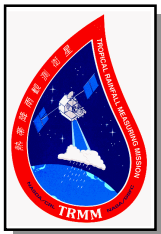
CERES Instrument

- Next turn on period will be determined by Terra checkout (Jan 27)
 - Will most likely not power OFF again due to converter voltage reading saturation
- Removal from ACS contingency load-shed plan
 - Powered off in Low Power conditions
 - Plan and Test result walk-through held on Dec. 15th
 - Awaiting final approval to place on board
- Open issues
 - Awaiting official closure of AR #69
 - » CERES DAA High Voltage on +15 V converter
 - Awaiting new TSMs for CERES current monitoring (CCR #045)
 - » Testing complete



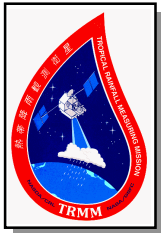
LIS Instrument

- MSFC Command Requests
 - Reset instrument to reduce data sequence errors, approximately once per month: on 99-343 and 99-363
 - » The maximum number of science packets are being received
- LIS Automatic Heater Controller Anomaly (AR #78)
 - Controller transitioned from primary to secondary heater on 99-288
 - » No temperature limits violated to warrant switch
 - Many heater transitions: sometimes both heaters left disabled
 - LIS Automatic Heater Controller disabled on 99-289
 - Awaiting MSFC report



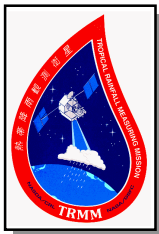
VIRS Instrument

- Instrument has been powered off 5 times since launch
- 10 Self-resets experienced since launch (AR #56)
 - AR #56 has been classified as “Inactive” for tracking
 - An LOP and a recovery procedure have been developed and tested
- Radiative Cooler (Inner Cold Stage)
 - Thermal shorts experienced during Deep Space Cals, Sun Acquisition, and Leonids resulted from the quick heating of the Cold Stage
 - » 4 out of the 5 Outgas operations performed were to correct thermal shorts
- On average, Solar Calibrations are performed once a month
- The FDF solution to the Solar Calibrations planning aid improvement request seems to have worked
 - Solution: Calibrations should only be performed at beta angles between 0° & 5°
- At the PI's request, the Blackbody Temperature is being maintained between 9°C & 16°C by manually turning the heater ON & OFF



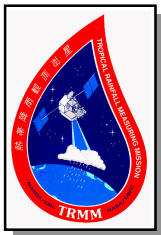
TMI Instrument

- No concerns or open issues



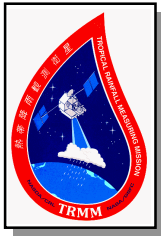
PR Instrument

- Normally 3 External Calibrations are done per month
- Delta-V prior to Y2K (normal orbit box exceeded)
 - Affected some PR science data
 - » PR temporarily lost the ground echo around the highest altitude
- Open Issues
 - Frequency agreement
 - » PR currently does not radiate over a region of Australia
 - » International PR Priority Agreement runs out at the end of 2000
 - What new restrictions will it place on the operation of PR?
 - Possibility of extention?



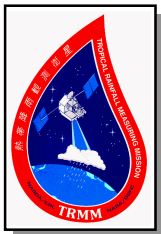
Ground System

- Operating on Release 8.0
 - Rejected Release 8.1 after testing revealed new DRs
 - » GRI configuration file, Table loads dependent on processor, GRI updates for processor switching
- Mission Planning still being run from string 2
 - Awaiting failover and parallel operations testing on string 3
- Building 32 power analysis
- Regular system problems
 - Regular hardware failures: disk drives, tape drives, cooling fans
 - Still getting Front End Processor and software failures occasionally
 - DKS continually having problems



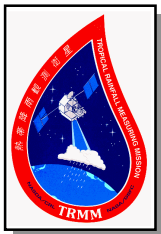
Ground System

- Event Reports
 - #144: Scheduling conflicts with STS, HST, and Terra
 - #145: GSFC Power Outage: UPS-1 failed as backup
 - #146: PTP-1 Failure (Q & NCC)
 - » Failed over to PTP-3
 - » Errors with PTP-2 (I) forced failover to PTP-3
 - All data now on PTP-3
 - » Misconfiguration on PTP-3 caused data errors and event problems
 - Ultimately caused data loss: ~8 min per science recorder



Upcoming Activities

- 0-1 Month
 - Zero Out Launch TSMs / Load new CERES TSMs
 - Zero Out Launch/Y2K RTSs (Noops) in RAM & EEPROM
 - SA Jitter Patch to EEPROM
 - Dump ACS / SC Memory and update GRIs
 - Upgrade ODB to version 11.2
 - Publish TRMM 18 Month Report
 - FOT/ACS/FDF Large Yaw Update Review Meeting
 - PSIB Patch Test Results Review and Uplink
 - String 3 Returned as Primary MP String



Upcoming Activities

- 1-3 Months
 - Implement new CERES Load-shed Scenario
 - Turn CERES Instrument On again
 - System Software Release 8.1 Delivery
 - Begin TRMM Continuous Risk Management Plan (per ESMO format)
- Ongoing
 - Continue to Close Remaining Open CCRs, MOCRs